REMARKS

Claims 1-17 are all the claims pending in the application.

The Specification

With respect to the Examiner's request to check the specification and correct any errors of which applicant may become aware, applicant has requested certain changes to the specification and these will shortly be made. Specifically, applicant desires to delete the word "type" in the terms "differential response-type" and "stationary response-type" at various pages, and it appears that it would be easier to submit a substitute specification than amend the various pages. A clean and a marked up copy of the substitute specification showing amendments will be submitted with the necessary Declaration indicating no new matter is presented. In line with the amendments to the claims, specifically the amendment to claim 8, the specification will be amended to agree with claim 8 at page 3. A minor typographical error will be corrected on page 7. The term "silicone" is change to --silicon-- at pages 1 and 2. Any other minor typos noted will be corrected.

Claim Rejections - 35 U.S.C. § 112

The Examiner refers to the word "type" in various claims. The term "type" is cancelled from the claims.

With respect to claims 11 and 12 reciting the limitation "said semiconductor" and it being unclear what semiconductor is referred to, claims 11 and 12 are amended to make this point clear.

Finally, with respect to claim 8 being rejected as being incomplete for omitting essential structural cooperative relationships of elements, the same applying to claims 9-15 and 17, claim 8 is amended in the manner which is believed responds to this rejection.

With respect to the amendment to claims 11 and 12, see page 3, lines 13-17 of the specification.

With respect to the amendment to claim 8, see page 55, line 14 to page 56, line 2 and Figs. 15 and 16 of the specification.

Withdrawal of all rejections based on 35 U.S.C. § 112 is requested.

Prior Art Considered

U.S. Patent 5,107,104 Miyasaka (Miyasaka); U.S. Patent 6,300,559 Ohmori (Ohmori); U.S. Patent 6,300,612 Yu et al (Yu); U. S. Patent 4,985,618 Inada (Inada).

The Art Rejections

All rejections are under 35 U.S.C. § 103(a).

Claims 1-4 over Miyasaka in view of Ohmori. Paragraph 6.

Claims 5-7 over Miyasaka in view of Ohmori further in view of Yu. Paragraph 7.

Claims 8, 10-12, 16 and 17 over Miyasaka in view of Ohmori further in view Inada. Paragraph 8.

Claims 9 and 13-15 over Miyasaka in view of Ohmori and in view of Inada and further in view of Yu. Paragraph 9.

The above rejections are respectfully traversed.

The Examiner's position on the prior art is set forth in detail in the Action and will not be repeated her excepted as appropriate to an understanding to applicants traversal which is now presented.

Traversal

As set forth in Paragraph 6, the Examiner's states:

> Miyasaka discloses a differential response light-receiving device having a semiconductor electrode 2 comprising a semiconductor sensitized by a dye 3, an ion-conductive electrolyte 6, and a counter electrode 5 (fig. 1; col. 4, lines 5-15). The device makes a time-differential response to light to output a current (fig. 4). (emphasis added)

Applicant must essentially disagree with the Examiner's assertion, for the reasons now advanced.

Amended claim 1 recites: "A differential response light-receiving device comprising: a semiconductor electrode comprising an electrically conductive layer and photosensitive layer containing a semiconductor sensitized by a dye; an ion-conductive electrolyte layer; and a counter electrode, said differential response light-receiving device making time-differential response to quantity of light to output a photoelectric current (emphasis added).

As described in the specification, the dye used for the photosensitive layer is not particularly limited if it can absorb a light in visible region, near infrared region, etc., and can sensitize the semiconductor fine particles. However, the dye is preferably selected from the group consisting of organic metal complex dyes, methine dyes, porphyrin dyes and phthalocyanine dyes, and is particularly preferably an organic metal complex dye. To make the photoelectric conversion wave range of the light-receiving device larger, and to increase the

photoelectric conversion efficiency, two or more kinds of the dyes are preferably used as a mixture or in combination (see page 18, lines 2-9 of the specification).

The dye preferably has an interlocking group, which can interact or adsorb to the surface of the semiconductor fine particles. Preferred interlocking groups include acidic groups such as -COOH, -OH, $-SO_3H$, $-P(O)(OH)_2$ and $-OP(O)(OH)_2$ and π-conductive chelating groups such as an oxime group, a dioxime group, a hydroxyquinoline group, a salicylate group and an α-keto-enolate group. Among them, particularly preferred are -COOH, $-P(O)(OH)_2$ and $-OP(O)(OH)_2$. The interlocking group may form a salt with an alkaline metal, etc., or an intramolecular salt. In the polymethine dye, an acidic group such as a squarylium ring group or a croconium ring group formed by the methine chain may act as the interlocking group (see page 18, lines 13-22 of the specification).

In contrast to the present invention, although the Examiner mentions "a semiconductor 2 comprising a semiconductor sensitized by a dye 3," it appears to be the Examiner's view that Miyasaka does not teach a semiconductor 2 comprising a semiconductor sensitized by a dye 3, but discloses an electrically conductive electrode substrate 2 (a film used herein) carrying <u>a photosensitive chromoprotein oriented</u> film 3 (emphasis added) (see column 4, lines 5-9, lines 40-42 and Figs. 1 and 2).

The photosensitive chromoprotein of Miyasaka is a biosubstance used as a photoreceptor and may be selected from among proteins originating from a living organism and derivatives thereof capable of absorbing light and efficiently converting the photoenergy into chemical work, for example, from the rhodopsin family including rhodopsin, bacteriorodopsin, etc. (sec

column 5, lines 50-59), different from the dye in the photosensitive layer in the present invention.

One major distinguishing feature of the present invention from Miyasaka lies in that the photoelectric current corresponding to the intensity of light, to which the semiconductor electrode of the present invention has sensitivity, shows a current density of generally 1 to 100 $\mu A/cm^2$ when a light having an intensity 1 mW is irradiated into the photosensitive layer (sec page 51, lines 16-17).

Specifically, Fig. 23(a) shows the relationship between the quantity of light and the photoelectric current provided by the differential response light-receiving device using a light source of a tungsten/halogen lamp (100 W) such that the differential response light receiving device of the present invention outputs a photoelectric current having a current density of +150 $\underline{\mu A}/cm^2$ (emphasis added)(see page 66, lines 11-14 and page 68, lines 20-23 of the specification). This a greatly larger than the approximately +20 nA/cm^2 of Miyasaka using a light source of a Xenon lamp (150 W) shown in Fig. 4 (see column 9, lines 4-11).

As a consequence, one of ordinary skilled in the art, referring to Miyasaka, would not be motivated to reach the present invention as recited in amended claim 1, and accordingly, amended claim 1 is not obvious over Miyasaka.

The Examiner further states as follows in Paragraph 6, lines 15-19, of the Action that:

> Ohmori discloses a dye-sensitized stationary response light-sensitized device having a semiconductor electrode comprised of a transparent electrode 2 and a photosensitive layer comprising a semiconductor 3 sensitized by a dye 4, an electrolyte layer 5 containing a redox species, and a counter electrode 6 (Fig. 1; col. 1, lines 26-37; col. 4, lines 17-24).

Ohmori does discloses a photosensitive layer having a semiconductor sensitized by a dye. However, Ohmori does not teach or suggest a differential response light-receiving device using the photosensitive layer as such.

Specifically, the difference between a dye-sensitized photoelectric conversion element conventionally used for a solar cell as disclosed in Ohmori (see column 1, lines 11-12, column 2, lines 57-60 and Fig. 1) and a differential response light-receiving device as disclosed in the present invention lies in that the differential response light-receiving device preferably does not include an electrolyte containing a redox species such as I^-/I^{3-} to transport electrons (see page 3, lines 4-18 of the specification).

In more detail, the differential response light-receiving device of the present invention has an ion-conductive electrolyte layer instead of a charge transfer layer containing a redox species. The ion-conductive electrolyte layer is preferably free of redox species (see amended claim 2), whereby the ion-conductive electrolyte layer <u>does not have</u> a function of supplying electrons to dye holes and/or a function of receiving electrons from a counter electrode. In the differential response light-receiving device of the present invention, light injected to a photosensitive layer excites a dye contained therein, electrons are injected from the excited dye to a semiconductor, and the electrons are transported to the counter electrode through an external circuit (see page 7, lines 19-28 of the specification).

Major distinguishing features of the present invention mentioned above as compared to Ohmori are illustrated in Fig. 23(a) herein showing that the differential response light-receiving device of the present invention makes a time-differential response to the quantity of light

(light-on and light-off) to output a spike-like differential photoelectric current of + 150 $\mu A/cm^2$ and approximately-70 $\mu A/cm^2$ (see page 68, lines 20-23 and Fig. 23 (a) of the specification).

Therefore, one of ordinary skill in the art referring to Ohmori would not be motivated to reach the present invention as recited in the amended claim 1, i.e., to modify Miyasaka, and, accordingly, amended claim 1 is not obvious over Miyasaka in view of Ohmori.

With respect to the amended dependant claims 2/1, 3/1 and 4/3, their patentability is believed clear from the above discussions concerning the amended claim 1.

With respect to the amended dependent claims 5/2, 6/5 and 7/6, their patentability is also believed clear from the above discussions concerning amended claim 1, as none of Miyasaka and Ohmori disclose a device having the limitations of amended claims 1 and 2.

With respect to the amended claims 8/1, 10/8, 11/10, 12/11, 16/1 and claim 17/2, their patentability is also believed clear from the above discussions concerning amended claim 1, as none of Miyasaka and Ohmori disclose a device having the limitation recited in amended claims 1 and 2.

With respect to the amended claims 9/(8 dependant from the amended claim 1), 13/10 (dependant from the amended claim 8), 14/13 and 15/14, their patentability is also believed clear from the above discussion concerning amended claim 1, as none of Miyasaka and Ohmori disclose a device having the limitation recited in amended claim 1.

Thus, applicant relies on the traversing arguments with respect to Miyasaka and Ohmori to traverse the rejections further in view of Yu and further in view of Inada and in view of Inada and further in view of Yu.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

IN THE CLAIMS:

The claims are amended as follows:

1. (Amended) A differential response~~-type~~ light-receiving device comprising: a semiconductor electrode comprising an electrically conductive layer and a photosensitive layer containing a semiconductor sensitized by a dye; an ion-conductive electrolyte layer; and a counter electrode, said differential response~~-type~~ light-receiving device making time-differential response to quantity of light to output a photoelectric current.

2. (Amended) The differential response~~-type~~ light-receiving device according to claim 1, wherein said ion-conductive electrolyte layer is free of redox species.

3. (Amended) The differential response~~-type~~ light-receiving device according to claim 1, wherein said semiconductor is a metal chalcogenide.

4. (Amended) The differential response~~-type~~ light-receiving device according to claim 3, wherein said semiconductor is a metal oxide selected from the group consisting of TiO_2, ZnO, SnO_2 and WO_3.

5. (Amended) The differential response~~-type~~ light-receiving device according to claim 2, wherein said differential response~~-type~~ light-receiving device comprises a plurality of semiconductor electrodes, photosensitive wavelengths of said plurality of semiconductor electrodes being different from each other, and said ion-conductive electrolyte layer is disposed between said plurality of semiconductor electrodes and said counter electrode.

6. (Amended) The differential response~~-type~~ light-receiving device according to claim 5, wherein said plurality of semiconductor electrodes are arranged in such order that said photosensitive wavelengths are increasing from light incident side of said differential response-type light-receiving device.

7. (Amended) The differential response~~-type~~ light-receiving device according to claim 6, wherein said plurality of semiconductor electrodes comprises a blue-sensitive semiconductor electrode, a green-sensitive semiconductor electrode and a red-sensitive semiconductor electrode arranged in this order from said light incident side of said differential response~~-type~~ light-receiving device.

8. (Amended) A composite light-receiving device comprising the differential response~~-type~~ light-receiving device recited in claim 1 and a stationary response~~-type~~ light-receiving device, said differential response light-receiving device and said stationary response-light-receiving device being arranged horizontally to said light-receiving surface or said differential response light-receiving device being stacked on said stationary response light-receiving device in the direction of light incidence.

9. (Amended) The composite light-receiving device according to claim 8, wherein said differential response~~-type~~ light-receiving device and said stationary response~~-type~~ light-receiving device are stacked.

10. (Amended) The composite light-receiving device according to claim 8, wherein said stationary response~~-type~~ light-receiving device comprises: a semiconductor electrode comprising an electrically conductive layer and a photosensitive layer containing a semiconductor sensitized by a dye; a charge transfer layer comprising a hole-transporting material or an electrolyte composition containing redox species; and a counter electrode.

11. (Amended) The composite light-receiving device according to claim 10, wherein said semiconductor within said stationary response light-receiving device is a metal chalcogenide.

12. (Amended) The composite light-receiving device according to claim 11, wherein said semiconductor within said stationary response light-receiving device is a metal oxide selected from the group consisting of TiO_2, ZnO, SnO_2 and WO_3.

13. (Amended) The composite light-receiving device according to claim 10, wherein said stationary response~~-type~~ light-receiving device comprises a plurality of semiconductor electrodes, photosensitive wavelengths of said plurality of semiconductor electrodes being different from each other, and said charge transfer layer is disposed between said plurality of

semiconductor electrodes and said counter electrode.

16. (Twice Amended) An image sensor comprising a plurality of pixels, wherein each of said pixels comprises the differential response~~-type~~ light-receiving device recited in claim 1.